

## EM Basic- Pulmonary Embolism Part 1- Risk factors, Symptoms, and Testing

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**Pathophys-** PE is usually from a clot in the deep veins of the lower extremities or pelvis and has travelled or embolized to the pulmonary vasculature. (Clots in upper extremity much less worrisome for PE- but its a whole other topic for another podcast)

Clot lodges into pulmonary artery -> increased pulmonary vasculature resistance -> decreased in preload.

Section of lung supplied by that pulmonary artery branch can't oxygenate -> hypoxia and chest pain

Clot causes mechanical obstruction of pulmonary artery -> backpressure on the right side of the heart -> left sided heart failure -> hypotension and shock

**Virchow's triad-** hypercoagulability, stasis, and vascular injury

Hypercoagulability- usually inherited diseases like Factor V Leiden, Protein C and S deficiency, also cancer

Stasis- staying still for a long period of time

Vascular Injury- some sort of injury to vascular basement membrane to form clot- while trauma does put pts at risk, doesn't have to be present- older pts (over 60) have older vasculature that is prone to "injury"

**PEARL-** don't need to identify all 3 factors to be at risk for a PE, this is the "classic" presentation

**Major PE risk factors**

**Intrinsic clotting disorders-** Factor V Leiden, Protein C and S deficiency (usually know this only if pt knows they have a history of it)

**Recent surgery/trauma**

**Pregnancy**

**Oral contraceptive pills (or any estrogen)**

**Cancer**

**History of previous PE/DVT**

**Advancing age (over 60)**

**Autoimmune disease (especially lupus)**

**Symptoms of PE-** classic "triad" is hemoptysis (present only 2.9% of time), chest pain (47%), and shortness of breath (79%)

**Pleuritic chest pain-** sharp stabbing chest pain in a broad area that is worse with deep breathing, coughing, or talking

**Vital sign abnormalities-** tachycardia, hypoxia, hypotension (sign of severe disease)

**PEARL-** take into consideration the whole picture with risk factors, signs and symptoms when deciding whom to workup for PE

**Gestalt-** "unstructured assessment that the patient has the disease based on the pre-test probability in light of the clinician's clinical experience and the available information"- AKA your "guy feeling"

**High risk patient (theoretical example)-** A pregnant female with a history of factor V Leiden who just got off a long plane flight with a unilateral swollen leg with chest pain, hemoptysis, shortness of breath, hypoxia, tachycardia, and hypotension

**Low risk patient-** A few minutes of chest pain in a 20 year old female with no PE risk factors (including OCP) without any vital sign abnormalities

**Medium risk patient (debatable- everyone has their own definition)** A 25 year old female on OCPs with some sharp chest pain that lasted a few hours with some shortness of breath now resolved, heart rate 105

**PEARL-** Gestalt can still be used with good accuracy even as a novice learner- one study- 1<sup>st</sup> year residents had 71% accuracy for PE diagnosis 74% for 2<sup>nd</sup> and 3<sup>rd</sup> year residents, and 78% for 4<sup>th</sup> year residents and attendings- only a 7% increase in accuracy from intern to attending

**PERC rule** (see essential evidence episode for a "deep dive" on this)

**First step-** decide that the patient is low risk based on gestalt- language of study was "a low enough risk that a board certified EM physician would be comfortable ruling out the diagnosis of PE if the d-dimer was negative"- approximately 15%

**If medium or high risk-** proceed immediately to advanced imaging (CT or V/Q)

**If low risk by gestalt-** apply the PERC rule

Mnemonic- **BREATHS**

**Blood** in the sputum (hemoptysis)

**Room air sat** less than 95%

**Estrogen use** (OCPs or other estrogens)

**Age** greater than 50

**Thrombosis-** either a PE/DVT in the past or current suspicion of a DVT

**Surgery or trauma** in the past 4 weeks

**If all negative-** stop the workup for PE- risk of PE is 1.6%, risk of harms from testing and treatment of DVT 1.8%- will cause more harm than benefit if you test these patients

**If any of those criteria are positive-** do a D-dimer

**If D-dimer is negative-** stop the workup for PE

**If D-dimer is positive-** get advanced imaging

**Other decision rules-** Well's, Revised Geneva- not as commonly used

**Workup for PE (after using a clinical decision rule)**

**Chest x-ray-** most patients have chest pain/shortness of breath- look for other causes like pneumothorax, pneumonia, pleural effusion, lung mass, etc.

**EKG-** looking for signs of cardiac ischemia, signs of MI- “classic” S1Q3T3 sign only about 20% sensitive

**Labs**

**CBC-** look for anemia as cause of chest pain, elevated WBC (infectious causes, low yield), low platelets (if PE found prior to anti-coagulation)

**Chem Panel-** Check creatinine for IV contrast for CTA

**Coags-** not very useful but often included on chest pain workup sets- most people want a baseline before anticoagulation but they probably won't be abnormal unless patient on warfarin AKA Coumadin

**HCG-** in all females of child bearing age

**Troponin-** useful for risk stratifying patients with PE once it is diagnosed **HOWEVER-** not everyone agrees with testing all patients with troponin right off the bat- if your CT is negative then you are now stuck with or one troponin- some will argue that “one set is no set” and you have to trend troponins to be sure this isn't ACS/MI. However, if you explain your chart that you don't think this is ACS/MI, you are on ok medico-legal ground. Wouldn't recommend novice learners suggest this right off the bat but be prepared to justify your decision to order/not order

**D-dimer-** measures the degradation products of cross-linked fibrin- do order this without using a clinical decision rule first! Only for low risk patients! Very sensitive for PE (95%) but false positives as high as 50 70%- causes a lot of unnecessary testing if ordered indiscriminately. D-dimer also increases with pregnancy to the point where it really isn't useful

**Advanced imaging**

**CT Pulmonary Angiogram- CTPA or CTA for short**

-Quick and easy to obtain in most EDs, very accurate and reveals other possible diagnoses that could cause chest pain/shortness of breath

-Limitations- patients with renal failure, patient exceeds the weight limit of the CT table, pregnancy (relative limitation- see below)

**V/Q scan-** IV radioactive tracer is injected to examine pulmonary vasculature followed by inhaling a radioactive tracer, if a lung segment ventilates but does not perfuse, it suggests a PE

-Limitations- much less accurate than CT, does not reveal alternate diagnoses, Chest x-ray needs to be completely clear for it to be useful

-Only useful if the test is read as completely negative/normal- a “low probability” of PE still has a risk of PE of 20% (way too high)

**Bilateral lower extremity ultrasounds-** in a patient with signs and/or symptoms suggestive of PE, a clot in the legs pretty much equals a clot in the lungs- however, if negative it's not helpful at all- can be used in pregnancy as an option but usually prefer better confirmation in form of CT or V/Q scan

## **Advanced Imaging for PE in Pregnancy**

### **CTA**

**-PROS-** in pregnancy, even one abdominal CT is still below known threshold of harm for radiation for the fetus so radiation should not be a concern, can adjust CT scanner settings to avoid scanning into the abdomen

**-CONS-** concern over radiation exposure, more non-diagnostic CT scans in pregnancy due to physiologic changes (changes in blood volumes and cardiac output), ? harms of contrast exposure in pregnancy for fetus (not proven in literature but likely never to get a good answer on this)

### **V/Q scan**

**-PROS-** if chest x-ray is normal then higher rate of diagnostic scans compared to CT, much less radiation exposure

**-CONS-** not as accurate as CT, radioactive tracer concentrates in the bladder which is right next to the uterus (can have patient urinate immediately after scan to reduce radiation exposure)

**PEARL-** follow your institution's guidelines in regards to choice of test and consenting patients for PE imaging in pregnancy . Go through the pros and cons of whatever imaging you choose and have the patient sign a consent form after a frank discussion of all the risks and benefits

**PEARL-** PE is a serious disease in pregnancy- you can't not pursue the diagnosis because the workup may be difficult